

17. *Fossil Carnivora from Hopefield*. By R. F. EWER, Zoology Department, Rhodes University, Grahamstown, and R. SINGER, Anatomy Department, University of Cape Town.

(With Plates XXVII-XXXII and 1 text-figure.)

## I. INTRODUCTION

The history and general appearance of the fossil site on the farm "Elandsfontein", 10 miles from Hopefield — a village 90 miles north of Cape Town — has already been described in a fairly detailed manner (Drennan, 1954; Singer, 1954). The movement of the exposed crescentic sand-dunes situated in the scrub-covered bushveld has uncovered calcareous floors from which a wealth of fossil material has been recovered by a research team of the University of Cape Town. Besides the human cranial fragments (see above publications, and also Drennan and Singer, 1955) and stone implements of the final phases of the South African hand-axe culture and of the Still Bay culture, many species of extant and extinct mammals have already been identified — Equidae, *Homoioceras* (?*Bubalus*) sp., *Palaeoloxodon* cf. *antiquus recki*, *Ceratotherium* and *Diceros*, *Giraffidae* (?*Sivatherium*), *Hippopotamus amphibius* and *Mesochoerus lategani* (Singer and Keen, 1955), and numerous types of antelopes (eland, wildebeest, lechwe, etc.). A small number of fossilized tortoise carapace fragments, shells of *Succinea*, land snails (*Trigonephrus globulus*), and a cranial fragment of a scaly anteater, have also been recognized. Fossil Carnivora are not abundant at Hopefield, but the remains which have been recovered to date show that the fauna included a viverrid, two hyaenids, a small felid, a *Lycaon*, a jackal and a mustelid. The material is described in detail below.

## II. DESCRIPTIONS

### 1. Family Viverridae

Specimen E.C.7: the top of a braincase with the greater part of the occiput.

In size and general conformation the specimen closely resembles *Herpestes ichneumon* (Linn.), but in view of its incompleteness no detailed comparisons are possible.

2. Family *Hyaenidae*

The Hyaenid remains represent two species, one of which is a *Hyaena*, closely resembling the living *H. brunnea*, and the other a large *Crocuta*.

(i) *Hyaena brunnea* Thunb.

Specimen E.C.2: right mandibular ramus, lacking the coronoid process and with I<sub>1</sub> and I<sub>2</sub> broken off; all the other teeth are present in a good state of preservation and showing only slight wear.

Specimen E.C.3: portion of left mandible bearing the canine, P<sub>2</sub>, P<sub>3</sub> lacking its anterior end, P<sub>4</sub> and slightly damaged M<sub>1</sub>. This almost certainly belongs to the same individual as E.C.2.

Specimen E.C.4: maxillary fragment with P<sup>3</sup>, P<sup>4</sup> and M<sup>1</sup>. These teeth occlude perfectly with those of E.C.3, and there is no doubt that they belong to the same individual.

Specimen E.C.6: maxillary fragment with P<sup>3</sup> and the anterior roots of P<sup>4</sup>.

Specimen E.C.11: maxillary fragment with milk carnassial and Mm<sup>4</sup>.

These specimens do not show any important differences from the living *Hyaena brunnea* Thunb. The measurements of the teeth are given below and compared with the corresponding values found for a sample of 15 specimens (13 measurements for mandibles) of the living brown hyaena (table 1). For each measurement of the latter the mean and standard deviation are given. From the ratio of the difference between the fossil measurement and the mean to the standard deviation can be found P, the probability of a specimen from the same population as the living specimens having a measurement as divergent as that of the fossil.

In the dimensions of the upper teeth none of the fossils differs significantly from the living species. In the case of teeth from the mandibles some slight differences are apparent: the carnassials and P<sub>3</sub> are slightly smaller, and P<sub>4</sub> is slightly narrower both absolutely and relatively. The smaller lower carnassial and slightly lesser development of the crushing specialisations of P<sub>3</sub> and P<sub>4</sub>, as reflected in their slightly smaller widths, are points in which the fossil specimens appear to be a little more primitive than their living counterparts. The differences are so slight, however, that it has not been considered necessary to place the fossil specimens in a distinct subspecies.

A subspecies of *Hyaena brunnea*, *H. brunnea dispar*, has been described by Ewer (1955) from Swartkrans. In this subspecies P<sup>4</sup> is slightly shorter than in the living form and P<sup>3</sup> is more primitive, the posterior cusp being rather large and the anterior ridge situated less internally. The Hopefield specimens do not show these characteristics. The only point of resemblance between the two is that P<sub>3</sub> in each case is shorter than in the living form, but

in the Hopefield specimen the tooth is smaller in both its linear dimensions, whereas in the *dispar* subspecies the width is not significantly different from that of the living form. There is thus little justification for including the Hopefield specimens in the *dispar* subspecies.

TABLE 1.

Measurements of fossil *Hyaena brunnea* compared with those of a sample of 13 mandibles and 15 skulls of living *H. brunnea*. For the latter the mean and its standard deviation are given.  $\frac{d}{\sigma}$  is the difference between the fossil measurement and the mean divided by the standard deviation of the latter. P gives the probability of a measurement as divergent as that of the fossil specimen being found in the population from which the sample of living *H. brunnea* was drawn. Values marked with an asterisk are statistically significant.

All measurements, in this and the succeeding tables, are given in millimetres.

	Specimen No.		Living <i>H. brunnea</i>		$\frac{d}{\sigma}$	P
	E.C. 2	E.C. 3	Mean	S.D.		
I <sub>3</sub> length .. .. .	7.1		6.60	.56	.89	> .05
breadth .. .. .	7.2		7.56	.41	.88	> .05
$\bar{C}$ length .. .. .	15.3	15.2	17.16	1.14	1.86	> .05
breadth .. .. .	12.2	11.9	13.35	.84	1.05	> .05
P <sub>2</sub> length .. .. .	14.8	15.1	15.55	.50	1.50	> .05
breadth .. .. .	10.0	10.5	11.03	.50	2.03	< .05 > .04
length : breadth ratio .. ..	1.48	1.44	1.41	.06	1.16	> .05
P <sub>3</sub> length .. .. .	19.6		21.17	.40	3.70	< .0004*
breadth .. .. .	12.7	12.7	14.40	.60	2.83	≧ .005*
length : breadth ratio .. ..	1.54		1.47	.06	1.20	> .05
P <sub>4</sub> length .. .. .	23.2	23.1	23.59	.56	.88	> .05
breadth .. .. .	12.4	12.4	13.80	.51	2.75	< .01 > .005*
length : breadth ratio .. ..	1.87	1.86	1.71	.06	2.67	< .01 > .005*
M <sub>1</sub> length .. .. .	22.4	22.4	24.56	.89	2.43	< .02 > .012*
breadth .. .. .	11.3	11.4	12.61	.43	3.05	< .003 > .001*
	E.C. 4	E.C. 6				
P <sup>3</sup> length .. .. .	23.1	22.2	22.88	.63	1.08	> .05
breadth .. .. .	15.9	15.9	15.98	.70	.11	> .05
length : breadth ratio .. ..	1.45	1.40	1.43	.05	.06	> .05
P <sup>4</sup> length .. .. .	35.8		35.31	1.08	.45	> .05
breadth .. .. .	21.1		21.48	.68	.56	> .05
M <sup>1</sup> length .. .. .	6.0		5.62	.38	1.00	> .05
breadth .. .. .	14.0		13.07	.87	1.07	> .05

(ii) *Crocota spelaea* (Goldf.).

Specimen E.C.1: posterior half of skull, broken off at about the level of the post-orbital constriction. The zygomata are missing and the auditory bullae broken, but otherwise the specimen is almost perfect (Pls. XXVII-XXIX).



Specimen E.C.9: mandibular fragment with much damaged  $P_2$ ,  $P_3$ ,  $P_4$  and the alveoli of  $M_1$ .

Specimen E.C.8: mandibular fragment with the anterior two thirds of  $M_1$  (Pls. XXX, XXXI).

Specimen E.C.5: maxillary fragment with  $P^3$  and damaged  $P^4$  (Pls. XXX, XXXI).

The skull is large and heavily built, the occiput high and narrow, and very distinctly "shouldered" (see Pl. XXVIII). The lambdoid and sagittal crests are well developed, and the latter is very high posteriorly. The conformation of this region is very similar to that of a skull of *Crocota spelaea* from Sundwig in the British Museum of Natural History (No. 28558) and an occipital fragment (M. 4570) from Torbryan Caves also shows similar development of the crests.

Goldfuss (1821) notes as a characteristic of *Crocota spelaea* the large development of the post-glenoid process. This is not at all an easy character to assess or to measure, particularly since in fossil material the tip of the process is commonly slightly damaged. From an examination of the *C. spelaea* material in the British Museum of Natural History it appears that, apart from its size, the post-glenoid process of *C. spelaea* differs from that of *C. crocuta* (Erxl.) in its orientation. In *C. spelaea* the process lies almost in the transverse plane of the skull, whereas in *C. crocuta* it slopes distinctly forward from its outer to its inner end. In specimen E.C. 1 the process is orientated as in *C. spelaea* (Pl. XXIX).

Unfortunately both the carnassials are damaged posteriorly, but the presence of posterior roots makes it possible to restore the missing portions with a fair degree of accuracy, and at least to determine a minimum length. In specimen E.C. 5 the palate is somewhat damaged at the posterior end of  $P^4$ , and it is therefore impossible to be quite certain that  $M^1$  was absent, but clearly if present at all it can only have been very small. The upper carnassial possesses the long metacone and relatively short parastyle characteristic of advanced Crocutas, but the protocone does not slope forward as much as is usual in *C. spelaea*. The lower carnassial, apart from its large size, is remarkable only for the structure of the anterior cingulum. This forms a sharp shelf-like excrescence round the antero-external margin of the tooth extending for just over 2 mm. and then ceasing abruptly at either end. Since the posterior portion of the tooth is missing the characters of the talonid are unknown.

The premolars do not provide any distinctive characters but closely resemble those of *Crocota crocuta*, except for their larger size. The posterior part of  $P_2$  is missing, but the posterior root is very broad:  $P_2$  in *C. spelaea* is commonly very wide at the posterior end.

The measurements of the specimens are given below, compared, in the same way as before, with the corresponding figures for *C. spelaea* (table 2). The only points of difference are that the premolars are a trifle narrower in the Hopefield than in the European specimens. In this character the Hopefield specimens resemble the *capensis* subspecies of *C. spelaea* described by Broom (1939) (see also Ewer 1954) from Kromdraai. *C. spelaea capensis*, however, differs from typical *C. spelaea* also in the large and almost square  $M^1$  and in the very long  $P^3$ , neither of which characters is shown by the Hopefield specimens. In addition the protocone of  $P^4$  in *C. spelaea capensis* is large and slopes forwards very considerably. The general narrowness of the premolars is a primitive character, and cannot, by itself, be taken to indicate any particular close relationship of the Hopefield specimens to *C. spelaea capensis*. The former are best regarded as closely resembling the typical European *C. spelaea*, differing only in the slightly more primitive character of the premolars. This difference does not seem of sufficient importance to

TABLE 2.

Measurements of Hopefield specimens of *Crocota spelaea*. The dimensions of the teeth are compared with those of a sample of *C. spelaea* from various European localities: the figure in brackets after the mean for the latter gives the number of specimens on which the mean is based. Other symbols as before.

*Specimen E.C. 1.*

Maximum vertical height of sagittal crest above upper edge of foramen magnum 81.6 mm.

Maximum vertical height of external occipital protuberance above foramen magnum 55.0 mm.

Maximum width across occipital condyles 47.0 mm.

Maximum width of skull (intersquamosal) 95.0 mm.

Maximum width across mandibular fossae ca. 124.0 mm.

		European sample		$\frac{d}{\sigma}$	P
		Mean	S.D.		
<i>Specimen E.C. 9</i>					
$P_2$ length	ca. 17.5	16.9 (31)	.85	.71	> .05
$P_3$ length	22.2	22.7 (33)	.78	.64	> .05
breadth	14.6	16.5	.93	2.04	$\approx$ .04
length : breadth ratio	1.52	1.38	.054	2.59	$\approx$ .01*
$P_4$ length	24.5	23.5 (32)	1.13	.89	> .05
breadth	13.5	14.9	.87	1.61	> .05
length : breadth ratio	1.81	1.58	.088	2.61	$\approx$ .01*
<i>Specimen E.C. 8</i>					
$M^1$ length	ca. 30.5	32.4 (26)	1.33	1.43	> .05
breadth	12.8	13.7	.73	1.23	> .05
<i>Specimen E.C. 5</i>					
$P^3$ length	24.3	24.1 (19)	1.34	.15	> .05
breadth	16.6	17.9	1.17	1.11	> .05
length : breadth ratio	1.46	1.35	.52	2.11	< .04 > .03
$P^4$ length	ca. 40	40.9 (27)	.92	.98	> .05
breadth	ca. 21	22.5	1.22	1.23	> .05

warrant the erection of a new subspecies for the Hopefield specimens, but should be borne in mind in considering the probable age of the deposit.

### 3. Family *Felidae*

(?) *Leptailurus serval* (Schreber).

Specimens E.C.15, E.C.17: mandibular rami, incomplete anteriorly and posteriorly, bearing P<sub>3</sub>, P<sub>4</sub> and M<sub>1</sub>.

Specimen E.C.16: portion of mandibular ramus with P<sub>4</sub> and M<sub>1</sub>.

The specimens all belong to a small felid, and the teeth do not show any peculiar characters. A set of skulls is not available to us for detailed comparison, but, judging from the measurements given by Roberts (1951), the specimens are a trifle too large to belong to the Cape wild cat, *Felis cafra* Desmarest, and fall within the range of *Leptailurus serval* (Schreber), to which species they are tentatively referred.

TABLE 3.  
Measurements of fossil specimens of *Leptailurus serval*.

	Specimen No.		
	E.C. 15	E.C. 16	E.C. 17
Depth of mandible between P <sub>4</sub> and M <sub>1</sub> .. .. .	13.5	15.2	ca. 15.5
P <sub>1</sub> length .. .. .	8.7		7.5
breadth .. .. .	4.8		3.9
P <sub>3</sub> length .. .. .	10.5	10.7	9.7
breadth .. .. .	5.8	5.1	5.1
M <sub>4</sub> length .. .. .	12.3	11.4	11.5
breadth.. .. .	6.2	4.9	5.5

### 4. Family *Canidae*

(i) *Lycaon pictus* (Temm.) n. subsp. *magnus*.

#### DIAGNOSIS:

A subspecies of *Lycaon* differing from the extant form in the greater length of the mandible, larger lower canines and incisors and longer but relatively narrower lower premolars.

Specimen E.C.13: portion of left mandibular ramus, incomplete below and bearing P<sub>1</sub> to P<sub>4</sub> and the anterior root of M<sub>1</sub>. (Pls. XXX, XXXI.)

Specimen E.C.121: right mandibular fragment bearing I<sub>2</sub>, I<sub>3</sub> and  $\bar{C}$ .

Specimen E.C.30: isolated damaged right M<sub>1</sub>.

All three specimens show moderate wear and are in a very similar state of preservation: it is probable that they belong to a single individual. Apart



from their distinctly greater length the teeth differ in no way from those of the living *Lycaon pictus* (Temminck). The measurements are given below, compared as before with those of the extant species. It will be seen that the fossil jaw is considerably longer than that of the extant species and that the teeth differ significantly from those of the latter in the following points: the premolars are considerably longer, but not much broader; the canine and  $I_1$  are significantly larger in both dimensions while the significance of the slightly greater breadth of  $I_2$  is less certain. It is considered that these differences are sufficiently clear cut to warrant placing the fossil specimens in a distant subspecies.

Wells & Cooke (1942) record from Vlakkraal a damaged  $M_1$  and a worn  $I_3$ ; the latter is said to be "a little larger than any specimen of this genus actually examined." It seems not improbable that this belongs to the same subspecies as the Hopefield material.

TABLE 4.

Dimensions of teeth of fossil *Lycaon* compared with those of a sample of 1 extant *Lycaon pictus*. Symbols as before.

	Specimen No.		Extant <i>L. pictus</i>		$\frac{d}{\sigma}$	P
	E.C. 12	E.C.13	Mean	S.D.		
Length from back of $P_4$ to front of $P_1$ .. .. .		52.8	40.7	1.79	6.76	<.0004*
$I_2$ length .. .. .	5.5		4.48	.57	.04	>.05
breadth .. .. .	5.6		4.71	.39	2.29	<.03>.02
$I_3$ length .. .. .	7.6		6.03	.47	3.34	<.001>.0004*
breadth .. .. .	6.5		5.66	.30	2.80	$\approx$ .005*
$\bar{C}$ length .. .. .	13.0		10.61	.72	3.32	<.001>.0004*
breadth .. .. .	9.1		7.80	.53	2.45	<.02>.012*
$P_1$ length .. .. .		8.1	6.45	.50	3.30	<.001>.0004*
breadth .. .. .		5.2	4.71	.35	1.42	>.05
length : breadth ratio ..		1.56	1.373	.119	1.57	>.05
$P_2$ length .. .. .		12.4	10.05	.62	3.79	<.0004*
breadth .. .. .		5.5	5.35	.25	.60	>.05
length : breadth ratio ..		2.25	1.879	.076	4.88	<.0004*
$P_3$ length .. .. .		14.3	11.95	.54	4.37	<.0004*
breadth .. .. .		6.3	6.08	.39	.56	>.05
length : breadth ratio ..		2.27	1.970	.130	2.30	<.03>.02
$P_4$ length .. .. .		16.5	13.75	.79	3.48	<.0004*
breadth .. .. .		7.3	7.11	.47	.40	>.05
length : breadth ratio ..		2.26	1.938	.100	3.22	<.003>.001*
$M_1$ breadth .. .. .	E.C. 30 10.4		9.92	.52	.92	>.05

(ii) *Canis mesomelas* Schreber.

Specimens E.C.18-20, 22-27 and 29; various incomplete mandibular fragments.

Specimen E.C.31: isolated M<sub>1</sub>.

Specimen E.C.32: isolated P<sub>4</sub>.

Specimen E.C.21: maxillary fragment bearing M<sup>1</sup> and M<sup>2</sup>.

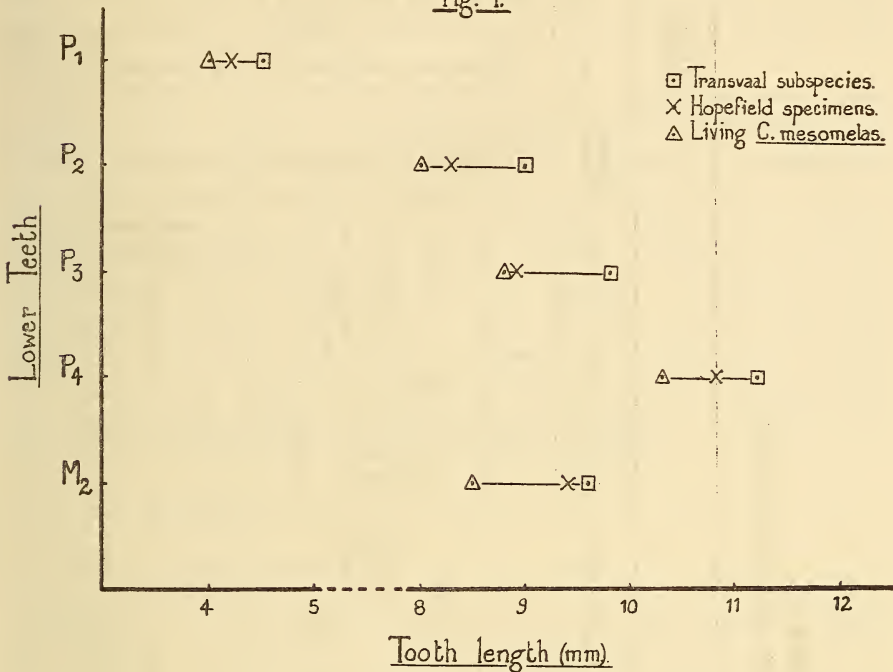
In another paper (Ewer, in the press) only a single character was found in which there was no overlap between the two living species of jackal, *Canis mesomelas* Schreber and *C. adustus* Sundevall, and which therefore allowed of a certain assignment of a single specimen to one or the other species. This character is the length of the carnassial tooth relative to that of the succeeding molar. This is referred to as the "carnassial: molar ratio" and either upper or lower ratios serve to separate the two species.

In the case of the material under discussion at present four specimens, E.C.18, 22, 25 and 26, include both M<sub>1</sub> and M<sub>2</sub> and therefore allow of the calculation of the lower carnassial: molar ratio. The values found are 2.03, 1.98, 2.10 and 2.30 respectively. For the samples of 14 *C. mesomelas* and 10 *C. adustus* used in the previous study the values range from 1.99 to 2.57 for the former and 1.60 to 1.81 for the latter. The Hopefield specimens clearly belong to *mesomelas*, and in the table of measurements the mean and range for the sample of extant *mesomelas* are given for comparison (table 5). It will be seen that although the means for the Hopefield specimens lie within the normal range for *mesomelas* a number of individual measurements lie beyond the upper size limit found for the living species.

A fossil subspecies of *C. mesomelas* has been described (Ewer, in the press) from the Transvaal deposits, differing from the living form principally in the fact that relative to the length of the carnassial M<sub>2</sub> is less reduced and the premolars are longer. It is therefore of some interest to compare the lengths of M<sub>2</sub> and of the premolars in the Hopefield specimens with the corresponding values for the Transvaal fossils. Figure 1 shows the mean values for the relevant dimensions, with those of the extant form for comparison. It will be seen that in each case the Hopefield value is intermediate between those for the Transvaal subspecies and for the living form. There seems to be little doubt that we are here dealing with a phylogenetic series in which a reduction of the molars and a shortening of the premolars is taking place; the Hopefield specimens representing a form ancestral to the living black-backed jackal and the Transvaal form in turn ancestral to the Hopefield. The functional significance of the changes is not at once apparent, and it may be that they would be better expressed by saying that a general reduction in overall size is taking place, but without any reduction in size of the carnassials, which therefore show an increase in relative size. Without



Fig. 1.



## VALUES.

Length(mm.)	Transvaal	Hopefield.	Living.
P <sub>1</sub>	4.5	4.2	4.0
P <sub>2</sub>	9.0	8.3	8.0
P <sub>3</sub>	9.8	8.9	8.8
P <sub>4</sub>	11.2	10.8	10.3
M <sub>2</sub>	9.6	9.4	8.5

whole skulls and skeletal material available it is not possible to decide whether this latter formulation is the more correct. It may be noted in passing that the Hopefield *Lycaon* also differs from the living species in possessing a longer premolar row.

A second fossil subspecies of *C. mesomelas* is known from African deposits. This is *Canis mesomelas latirostris* (Pohle) from Olduvai and Serengeti. This subspecies is distinguished from the living form by its very broad snout and shorter and less inflated auditory bulla. In the absence of a complete skull no adequate comparison of our material with this subspecies is possible, but Pohle (1928) gives measurements for the lengths of the teeth of his three specimens. The lower premolars resemble those of the Hopefield specimens in being rather longer than is usual in living *C. mesomelas*, but M<sub>2</sub> (present in

TABLE 5.  
Measurements of teeth of fossil jackals compared with mean values for a sample of 14 living *Canis mesomelas*.

	Specimen No.														Living <i>C. mesomelas</i>	
	E.C. 18	E.C. 22	E.C. 26	E.C. 29	E.C. 25	E.C. 19	E.C. 31	E.C. 23	E.C. 32	E.C. 20	E.C. 24	E.C. 27	E.C. 21	Fossil Mean	Mean	Range
P <sub>1</sub> length .. breadth ..						4.2 2.8								4.2 2.8	4.0 2.7	4.8-3.4 3.2-2.3
P <sub>2</sub> length .. breadth ..						8.3 3.7								8.3 3.7	8.0 3.3	9.0-7.2 3.8-2.4
P <sub>3</sub> length .. breadth ..					8.9 3.7	9.1 3.9				9.7 3.9	7.9 3.2			8.9 3.7	8.8 3.5	10.0-7.1 4.0-3.0
P <sub>4</sub> length .. breadth ..				ca. 11.0	10.3 4.5	10.9 5.2			12.1 5.1	10.4 4.6	9.2 3.9	12.0 5.9		10.8 4.9	10.3 4.3	11.5-9.2 4.8-3.6
M <sub>1</sub> length .. breadth ..	20.3 8.7	19.0 7.7	21.1 8.6	ca. 17.9 ca. 7.7	17.6 6.8	19.2 8.8	17.9 7.1	18.2 7.5				ca. 90.0		18.7 7.9	18.8 7.2	20.7-16.5 8.2-6.5
M <sub>2</sub> length .. breadth ..	10.0 7.7	9.6 6.7	9.2 6.9	9.8 ca. 7.8	8.4 6.1									9.4 7.0	8.5 6.3	9.6-7.4 7.0-5.7
M <sub>3</sub> length .. breadth ..					3.6 3.4									3.6 3.4	4.2 3.8	4.9-3.5 4.3-3.3
M <sub>4</sub> length .. breadth ..													12.2 14.0	12.2 14.0	11.8 13.7	13.7-10.3 15.5-11.7
M <sub>5</sub> length .. breadth ..													7.9 10.5	7.9 10.5	6.8 10.5	7.8-6.2 11.5-9.8

2 specimens) is shorter than in the Hopefield material. In the absence of a skull it seems unwise to assign our material to Pohle's subspecies, particularly since the Transvaal subspecies does not show the characters of snout and bulla diagnostic for *C. mesomelas latirostris*.

The Hopefield specimens thus appear to be the middle term of a series leading from the Transvaal subspecies to the extant black-backed jackal. As must always be the case when a fossil record approaches completeness, this situation raises difficulties in nomenclature. The exact point at which a progressive change is taken to be of sufficient importance to warrant nomenclatural recognition must be largely a matter of individual judgment. In the present case it is felt that since the majority of measurements for the Hopefield specimens fall within the range of values found for the living specimens, the erection of a separate subspecies is not likely to be useful. Nevertheless, when questions of dating are being considered the intermediate character of the Hopefield specimens between the extant *C. mesomelas* and the Transvaal fossil subspecies must be borne in mind.

##### 5. Family *Mustelidae*

###### *Mellivora capensis* (Schreber).

Specimen E.C.14: an almost perfect skull, with the zygomata missing (Pl. XXXII).

Specimen E.C.14 very closely resembles the living honey-badger, *Mellivora capensis* (Schreber), and differs only in its rather smaller size and the fact that the palate is considerably less prolonged posteriorly. The measurements of the fossil specimen are given below compared with those of the living form (table 6). It will be seen that although the fossil skull is considerably shorter than the mean for the sample of 15 living *Mellivora capensis* the variability of the latter is so high that the difference is not significant. The post-orbital width is significantly less in the fossil than in the living specimens; but when the smaller size of the fossil is taken into account, by expressing the post-orbital width as a percentage of the basilar length, the difference is no longer significant. The palate is, however, significantly shorter in the fossil than in the living species, both absolutely and when expressed as a percentage of the basilar length.

The fossil specimen thus differs from extant *Mellivora capensis* only in having the palate less prolonged posteriorly. On the basis of a single specimen, and bearing in mind that the difference is significant only at the 2% level, it does not seem desirable to erect a separate subspecies for the Hopefield *Mellivora*; but, as has been emphasised before, the fact that the Hopefield specimen is distinguishable from the living species must not be lost sight of in considering problems of dating.



TABLE 6.

Measurements of Hopefield *Mellivora* compared with the corresponding measurements for a sample of 15 extant *M. capensis*. Symbols as before.

	Specimen E.C. 14	Extant <i>M. capensis</i>		$\frac{d}{\sigma}$	P
		Mean	S.D.		
Basilar length .. .. .	113.0	123.43	6.636	1.57	> .05
Palate length .. .. .	50.4	60.65	4.389	2.34	≅ .02*
Posterior palate width <sup>1</sup> .. .. .	16.6	19.45	1.354	2.10	< .04 > .03
Postorbital width .. .. .	28.2	34.47	1.533	4.09	< .0004*
Maximum cranial width .. .. .	63.0	65.81	3.540	.79	> .05
Width of nasal aperture .. .. .	13.3	15.63	1.579	1.48	> .05
Length of P <sup>4</sup> .. .. .	10.8	12.67	1.133	1.65	> .05
Width of palate at level of P <sup>4</sup> .. .. .	39.6	45.33	3.114	1.84	> .05
Palate length as % of basilar length .. .. .	44.60	49.226	1.990	2.32	≅ .02*
Posterior palate width as % of basilar length .. .. .	14.69	15.780	.968	1.13	> .05
Postorbital width as % of basilar length .. .. .	24.96	28.026	1.704	1.80	> .05

<sup>1</sup> This is the width across the posterior end of the hard plate.

### III. DISCUSSION.

The faunal remains described above may be considered in terms of the light they may throw on two problems: the date at which the Hopefield deposit was laid down, and the ecological nature of the locality at that time.

As regards the latter point the carnivore fauna adds little to our knowledge. All the species described are very similar to species which have existed within the area during historic times. One curious point is that although hyaenas and jackals are present, no remains of large carnivores, such as leopard and lion, have to date been discovered. Artiodactyl and horse remains are abundant, and it seems very improbable that in fact no large carnivore predators were present. It seems likely that further work may bring lion or leopard remains to light, and their absence cannot at this stage be taken as established.

As regards the date of the deposit it is quite clear on the one hand that it is much more recent than the Transvaal deposits. The species represented are all closely related to living forms, and no trace has been found of the archaic hyaenids, *Lycyaena* and *Leecyaena*, and the sabre-teeth which exist in the latter deposits. At the same time the fact that most of the specimens show slight differences from their living counterparts indicates that the deposit cannot be of very recent origin, but is likely to be at least as old as the upper Pleistocene. The Vlakkraal deposit in which was found the large *Lycaon* incisor previously mentioned is estimated to belong to the upper Pleistocene (Wells & Cooke 1942). Chemical analyses, carried out through the courtesy of Dr. K. Oakley of the British Museum, on a fragment of *Hyaena brunnea* mandible indicate that the fluorine content does not differ from that of the

human skull and of *Mesochœrus lategani*. The carnivore fossils *per se* do not provide any grounds on which it would be possible to decide whether the deposit belongs to the upper Pleistocene, as has been suggested (Singer & Keen, 1955), or is as old as the top of the middle Pleistocene.

#### SUMMARY

All the carnivore remains so far recovered from the Hopefield site are described. These include a new subspecies of *Lycaon*, *Lycaon pictus magnus*, a *Crocuta spelæa* and a jackal showing characters intermediate between the fossil subspecies from the Transvaal cave deposits and the living form, together with a *Hyaena brunnea* and a *Mellivora capensis*, each differing very slightly from the corresponding living form. In addition there are fragmentary remains of a viverrid resembling *Herpestes ichneumon* and a felid, probably *Leptailurus serval*.

It is concluded that the carnivore fauna is consistent with the upper Pleistocene dating which has previously been suggested for the deposit.

#### ACKNOWLEDGEMENTS

We are indebted to Dr. Hewitt of the Albany Museum, to Dr. K. H. Barnard of the South African Museum and to Mr. Skead of the Kaffrarian Museum for their allowing us every facility for studying skulls in their collections and for the loan of material. One of us (R.F.E.) is also indebted to the authorities of the British Museum (Natural History) for facilities for examining and measuring material in their collections, and to the South African Council for Scientific and Industrial Research for a research grant.

Mr. G. McManus, Department of Surgery, University of Cape Town, kindly photographed the specimens.

Part of a research grant from the Dr. C. L. Herman Research Fund of the University of Cape Town allocated to Drs. Singer and Keen was utilized for studying the carnivora.

One of us (R.S.) is indebted to the Wenner-Gren Foundation for Anthropological Research, New York, whose motor vehicle, donated to the University of Cape Town, is being extensively used for collection of material from the site.

Publication of this paper was assisted by a grant-in-aid made by the Council of the University of Cape Town.

#### REFERENCES

- BROOM, R. 1939. A preliminary account of the Pleistocene carnivores of the Transvaal caves. *Ann. Transv. Mus.* 19, 331-338.
- DRENNAN, M. R. 1954. Saldanha Man and his Associations. *Amer. Anthropologist* 56, no. 5, 879-884.
- DRENNAN, M. R. and SINGER, R. 1955. A Mandibular Fragment, probably of the Saldanha Skull. *Nature* 175, 364.
- EWER, R. F. 1954. The fossil carnivores of the Transvaal caves. The Hyaenidae of Kromdraai. *Proc. Zool. Soc. Lond.* 124, 565-585.
- EWER, R. F. 1955. The fossil carnivores of the Transvaal caves. The Hyaenidae, other than *Lycyaena*, of Swartkrans and Sterkfontein. *Ibid.* 124, 815-837.
- EWER, R. F. (in press). The fossil carnivores of the Transvaal caves. *Canidae*. *Ibid.*
- GOLDFUSS, G. A. 1821. Osteologische Beiträge zur Kenntniss verschiedener Säuge-thiere der Vorwelt. Über die Höhlen-Hyäne (*Hyäne spelæa*). *Nova. Acta Akad. Caes. Leop.* 456-462.
- POHLE, H. 1928. Die Raubtiere von Oldoway. *Wiss. Ergeb. Oldoway-Expedit* 1913. N.f. Hfr. 3. 45-54.
- ROBERTS, A. 1951. The Mammals of South Africa. Published by the Trustees of the "Mammals of South Africa" Book Fund.
- SINGER, R. 1954. The Saldanha Skull from Hopefield, South Africa. *Amer. J. Phys. Anthropol.* n.s. 12, no. 3, 345-362.
- SINGER, R. and KEEN, E. N. 1955. Fossil Suiformes from Hopefield. *Ann. S. Afr. Mus.* 42, 169-179.
- WELLS, L. H. and COOKE, H. B. S. 1942. The associated fauna and culture of the Vlakkrail thermal springs, O.F.S. *Trans. Roy. Soc. S. Afr.* 29, 203-233.